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Dabringhausen et al.

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(54) **GROUND CONNECTION TO A LAMP HOUSING**

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PCT Pub. Date: **Oct. 31, 2013**

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H01J 5/50	(2006.01)
H01J 5/54	(2006.01)

(52) **U.S. Cl.**
CPC ***H01J 5/54*** (2013.01)

(58) **Field of Classification Search**
CPC H01J 5/50; H01J 5/00; H01J 5/46; H01J 5/54
USPC 313/318.01, 318.05, 318.06, 318.12
See application file for complete search history.

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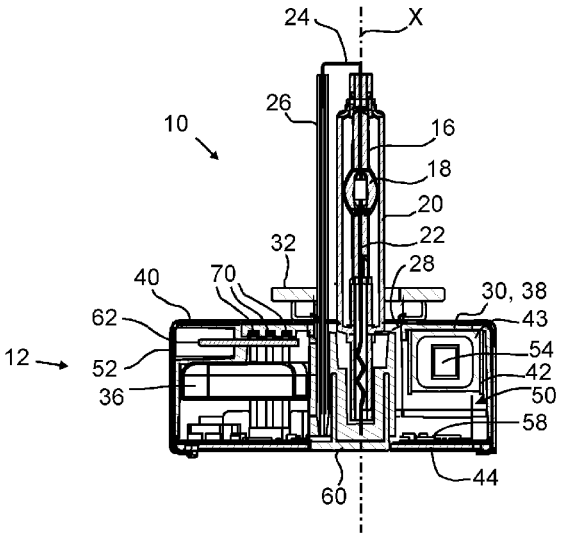
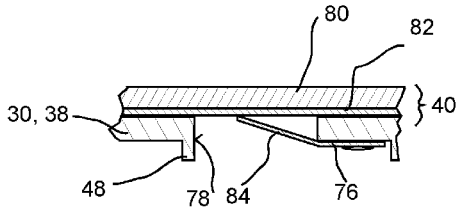
(57) **ABSTRACT**

A lamp (**10**) is described comprising a burner (**14**) fixed to a lamp base (**12**). The lamp base (**12**) comprises a metal housing part (**40**). The metal housing part (**40**) comprises a contact sheet element (**82**) made out of a different metal material. Electrical contacts are provided within the base (**12**), including an electrical ground contact (**70**). A contact spring (**76**) is provided for contacting the electrical ground contact (**70**) to the metal housing part (**40**). The contact spring (**76**) is arranged to press against the contact sheet element (**82**) to provide electrical ground connection to the metal housing part (**40**).

11 Claims, 5 Drawing Sheets





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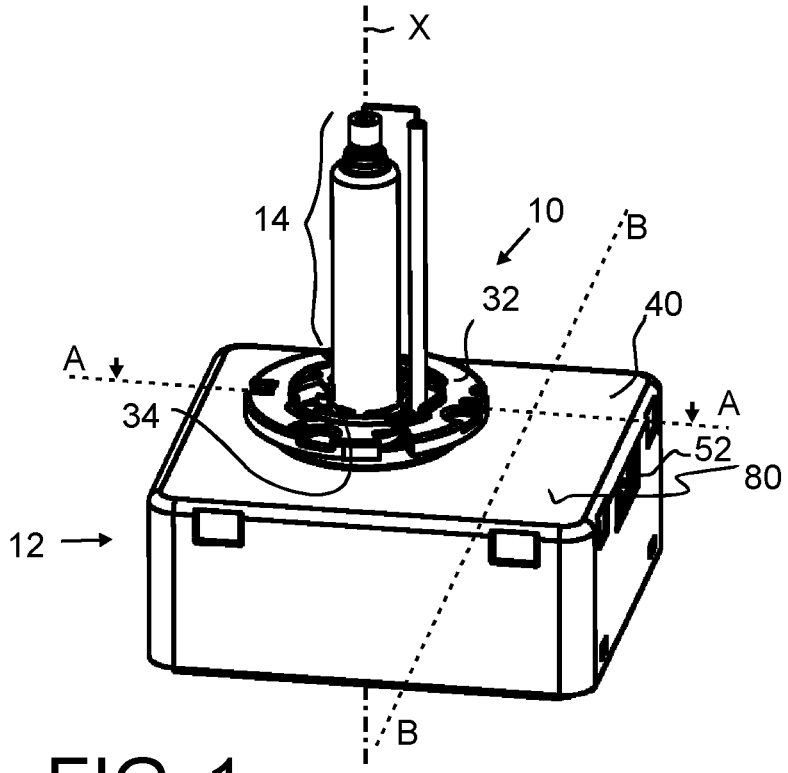

X
14
10
B
32
40
A
34
A
52
80
12
B

FIG. 1

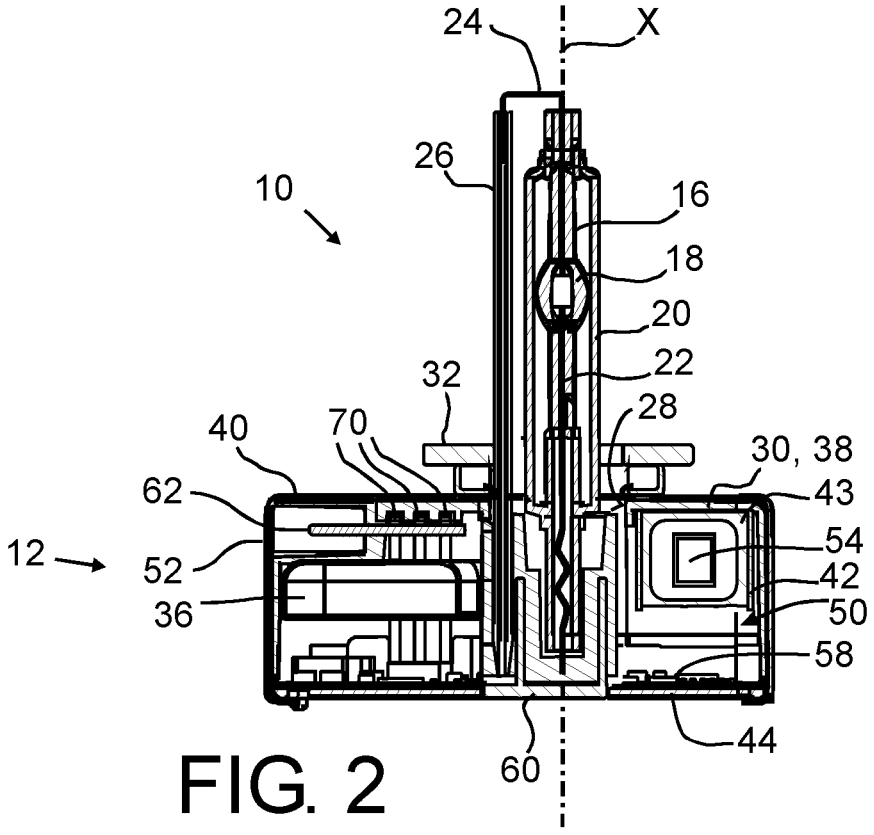

24
X
26
10
16
18
20
22
32
28
40
70
30, 38
62
43
12
54
52
42
36
50
58
44
60

FIG. 2

FIG. 3

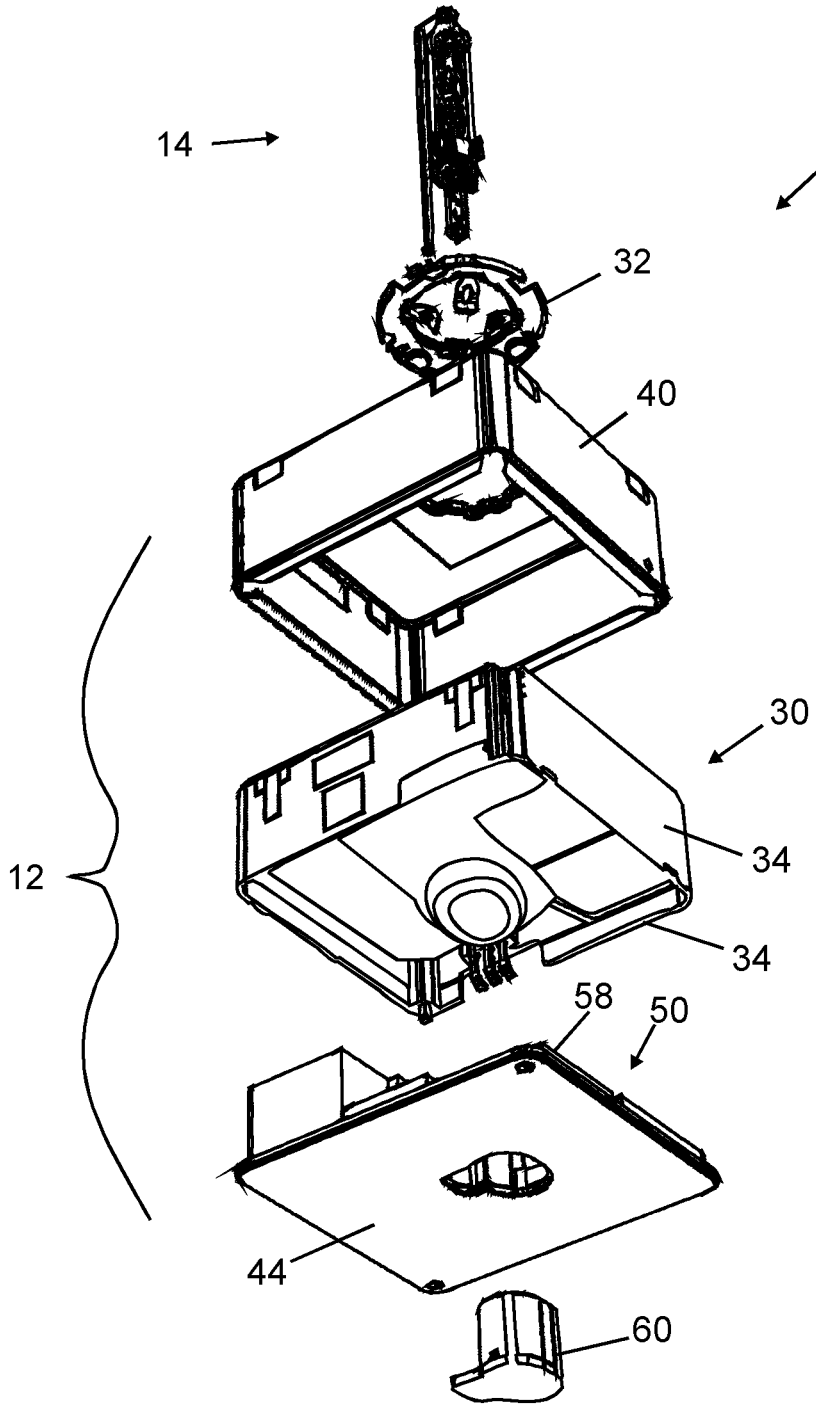


FIG. 4

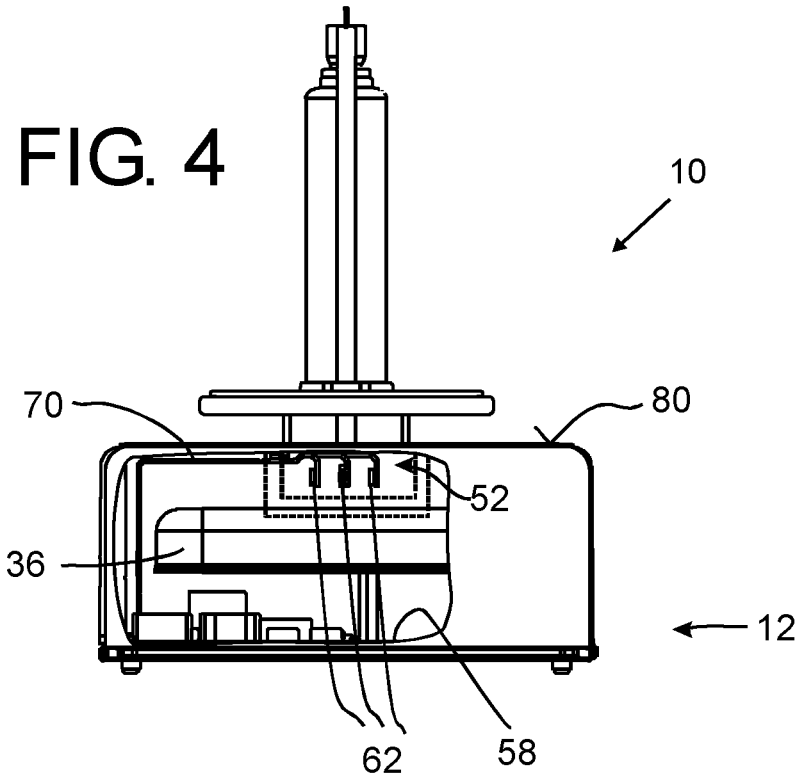


FIG. 5

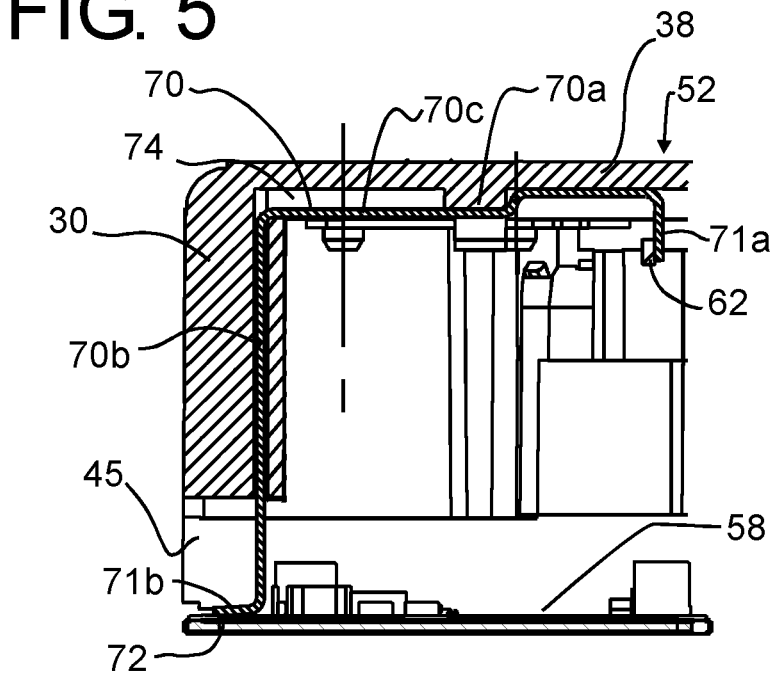
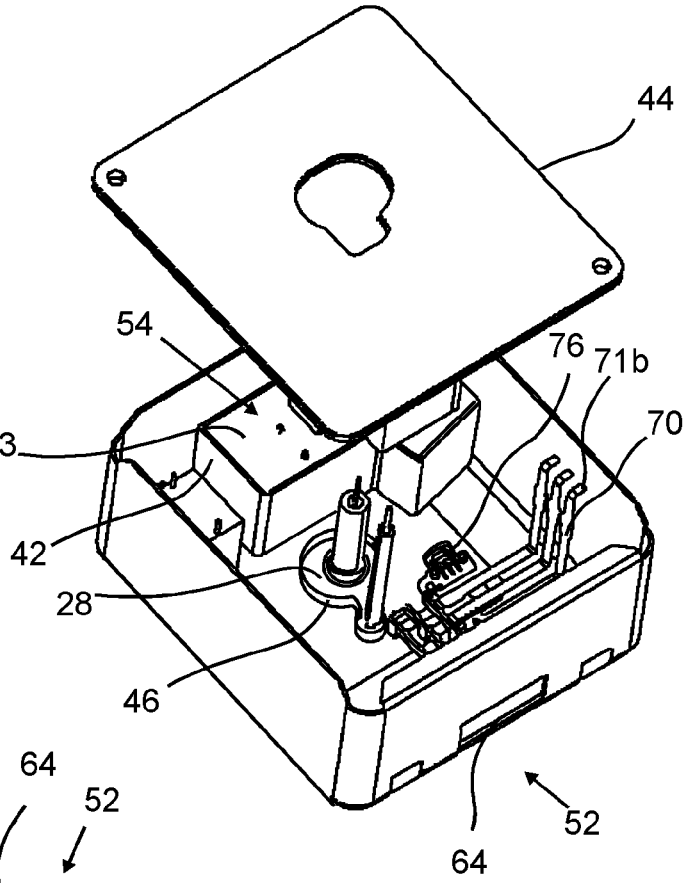


FIG. 6



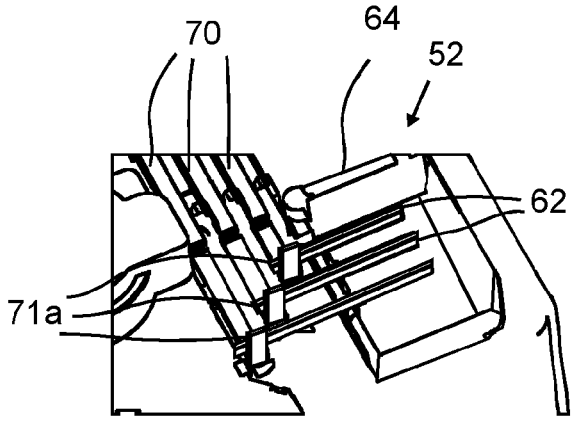


FIG. 7

FIG. 9

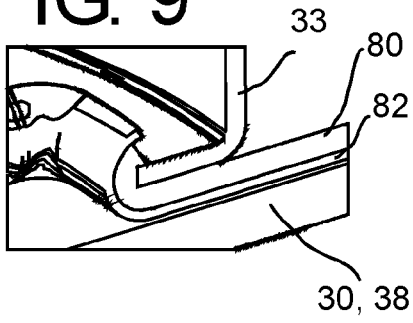


FIG. 8

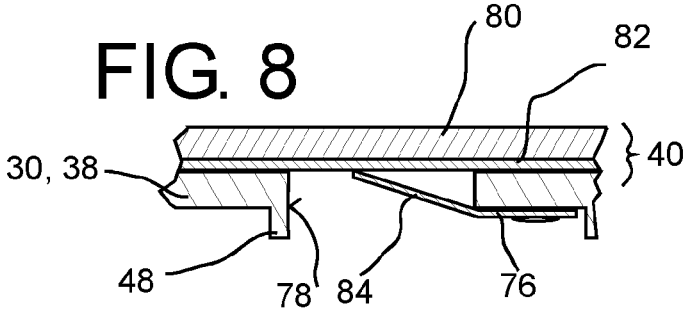
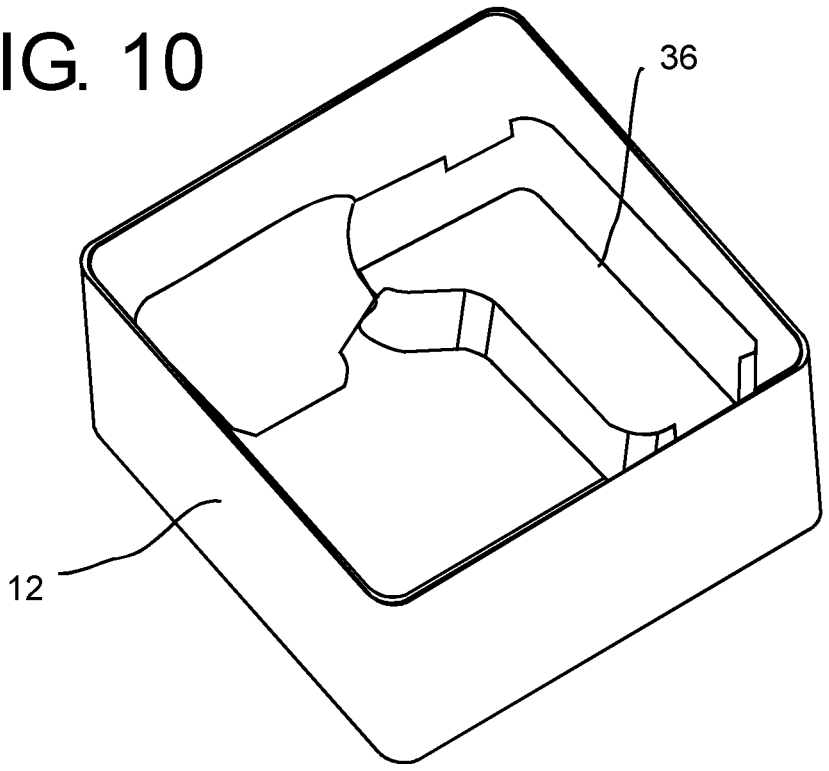


FIG. 10



GROUND CONNECTION TO A LAMP HOUSING

CROSS-REFERENCE TO PRIOR APPLICATIONS

This application is the U.S. National Phase application under 35 U.S.C. §371 of International Application No. PCT/IB2013/052974, filed on Apr. 15, 2013, which claims the benefit of U.S. Provisional Patent Application No. 61/638,582, filed on Apr. 26, 2012. This application is hereby incorporated by reference herein.

TECHNICAL FIELD

The present invention relates to the field of lamps, and more specifically to a lamp comprising a burner fixed to a lamp base. In particular, the present invention relates to lamps for use in a vehicle headlight, where the burner comprises a discharge vessel to generate light from an electrical arc discharge generated between electrodes.

BACKGROUND OF THE INVENTION

In electrical lamps, particularly in high intensity discharge (HID) lamps, reliable connection of housing parts to electrical mass or ground is desirable, both for security reasons and for reduction of electromagnetic interference (EMI). This especially applies for discharge lamps, where the lamp base comprises at least a part of the operating electronics, i.e. a driver circuit for operation of the burner and/or starting apparatus for igniting the arc discharge.

US 2006/0119282 A1 describes a high-pressure discharge lamp having a lamp base with an integrated starting apparatus. An electromagnetic shield is provided, which is connected to the ground reference potential of an operating device. The electromagnetic shield is provided as a metal housing which surrounds the lamp base, and has an aperture for a discharge vessel and for electrical connection of the lamp. The metal housing is made from aluminum or from an aluminum/magnesium alloy, or from a galvanized steel sheet. Inside, a lead frame is provided with electrical components of the starting apparatus, which comprises metallic webs embedded in electrically insulating plastic. A metallic tongue protrudes from the lead frame and out of the interior of the lamp base. In the mounted state, the metallic tongue of the metal web is in electrical and mechanical contact with a wall part of the metal housing. The metallic web, in a similar manner to a leaf spring, bears against the metal housing with a clamping fit.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a lamp with a reliable ground connection to a housing part, which is simple to manufacture.

This object is solved by a lamp according to claim **1**. Dependent claims refer to preferred embodiments of the invention.

The lamp according to the invention comprises a burner, preferably a HID burner, fixed to a lamp base. The lamp base comprises at least a metal housing part. Preferably, the lamp base comprises a metal housing at least partly surrounding the lamp base to the sides. Further preferred, the lamp base is fully enclosed in a metal housing, except for an opening to the burner and for an electrical plug/socket connection.

Within the base, electrical contacts are provided, which may be part of operating circuitry or the burner. One of the electrical contacts is an electrical ground contact.

According to the invention, the electrical ground contact is electrically connected to the metal housing part by a contact spring. However, the metal housing part comprises a contact sheet element made out of a different metal material, and the contact spring is arranged to press against the contact sheet to provide an electrical ground connection to the metal housing part.

Thus, the electrical connection of the electrical ground contact within the housing to the metal housing part is established via the contact spring and the contact sheet element.

This construction according to the invention allows to choose the different parts of the metal housing part and of the contact sheet element differently according to their purpose, e.g. with respect to the metal material and thickness thereof. The contact sheet element may be chosen in order to achieve high contact reliability and low contact resistance. Suitable materials include e.g. steel, copper or other metal materials with good contact properties. Preferably the contact sheet may be a thin (e.g. 0.1-0.4 mm thickness) sheet of steel.

The metal housing part, on the other hand serves for stability and for heat conduction and/or radiation. For example, an aluminum material may be preferred. Oxidation on an aluminum material, which may lead to adverse contact properties, is not a problem, because the electrical contact is established via the contact sheet element.

By virtue of the present invention, it is possible to provide a metal housing suitable for the lamp base, while at the same time electrical contact is reliably provided through the contact sheet element.

According to preferred embodiments of the invention, the contact sheet element and the metal housing part are provided as flat metal materials with their surfaces on top of each other. This allows a close connection of the contact sheet element and the metal housing part, ensuring reliable contact. Preferably, the metal housing part has a greater thickness than the contact sheet element.

It is preferred to connect the contact sheet element and the metal housing part by a deformation of both elements, thereby mechanically locking the contact sheet and the metal housing part. For example, the two elements may be connected by a crimping or riveting connection. This type of connection may easily be made during manufacturing, ensuring a both mechanically and electrically reliable connection.

According to a further preferred embodiment of the invention, a holding element for the burner is provided on a top surface of the lamp base. The metal housing part is provided at least at the top surface of the base, oriented towards the burner. The burner holding element, preferably a burner holding ring, may serve to mechanically hold the burner and/or to mechanically fix the lamp to a reflector, e.g. via a bayonet connection. The burner holding element is preferably fixed to the top surface by a deformation of the metal housing part and of the contact sheet element. Thus, by one and the same deformation, which may be e.g. crimping, riveting, bending, etc, the purposes of fixing the burner holding element and of connecting the contact sheet element to the metal housing part are served.

According to a preferred embodiment of the invention, there is a non-conductive holder element disposed within the housing, and the contact spring is fixed to the holder element. Preferably, the electrically insulating holder element is made out of plastic material and disposed within a metal housing. The holder element preferably serves to hold components of the operating circuit for the burner, such as e.g. contact leads

of a leadframe and components of a driver circuit and/or ignitor. It is further preferred that the holder element forms an enclosure of a plug/socket connection accessible from the outside to provide an electrical connection of the lamp to an external power supply, such as the onboard electrical supply of a motor vehicle.

Preferably, the non-conductive holder element comprises an opening, and the contact spring extends through the opening to contact the metal housing part via the contact sheet element. This allows to easily fix contact leads and/or electrical components to the holder at an insulation distance from the metal housing.

It is preferred that the lamp base comprises an electrical plug/socket connector with multiple electrical contacts, one of which is an electrical ground/mass contact, electrically connected to the contact spring. The connector further preferably comprises a supply voltage contact and may include a further contact for transmission of control signals.

The contact spring is preferably made from a flat spring material, such as e.g. brass material with nickel plating, or steel. It preferably comprises at least one spring tongue pressing against the contact sheet. Further preferred is to provide multiple elements, such as at least two spring tongues, to improve electrical contact also under adverse mechanical conditions.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments hereinafter.

In the drawings,

FIG. **1** shows a perspective view of an embodiment of an automotive HID lamp;

FIG. **2** shows a sectional view of the lamp of FIG. **1** with the section along A . . . A in FIG. **1**;

FIG. **3** shows an exploded view of the lamp of FIG. **1**, FIG. **2**;

FIG. **4** shows a side view of the lamp of FIG. **1-3** with a partially cut-away housing;

FIG. **5** shows an enlarged partial sectional view of the lamp of FIG. **1-4** with the section along B . . . B in FIG. **1**;

FIG. **6** shows a perspective exploded view of parts of the lamp of FIG. **1-5**;

FIG. **7** shows a perspective view of parts of the lamp of FIG. **1-6**;

FIG. **8** shows a partial sectional view of the lamp of FIG. **1-7**;

FIG. **9** shows a sectional perspective view of parts of the lamp of FIG. **1-8** with the section along A . . . A in FIG. **1**;

FIG. **10** shows a perspective view of parts of the lamp of FIG. **1-9**, including an electromagnetic shield.

DESCRIPTION OF EMBODIMENTS

FIG. **1** shows a lamp **10** including a lamp base **12**, from which a burner **14** protrudes.

As visible in particular from the cross-sectional view of FIG. **2**, the burner **14** is comprised of a burner tube **16** forming a discharge vessel **18** with an enclosed discharge space and an outer bulb **20** arranged around the discharge vessel **18**. The outer bulb **20** and the burner tube **16** with the discharge vessel **18** are made of quartz glass material. Within the discharge space, which comprises a filling of metal halides and Xenon, a first and second electrode are provided. The first electrode is electrically connected to a first, central contact lead **22** extending within the burner tube **16** into the housing **12**. A second electrode is connected to a return contact lead **24** extending in parallel to the longitudinal axis X of the burner **14**. A ceramic tube **26** is arranged around the return contact lead **24** for insulation.

The burner **14** is mechanically held relative to the lamp cap housing **12** by a holding ring structure **32** provided around the burner **14**, fixed to a collar of the burner **14** by spot-welded spring tongues.

The lamp base **12** comprises a metal outer housing **40**, an inner housing holder element **30**, and a bottom plate **44**. All of the outer housing wall elements **40**, **44** are made out of aluminum as a metal material of good heat conduction properties. The inner holder element **30** is made out of a plastic material.

Within the lamp base **12**, electrical components of a lamp operating circuit **50** are arranged. The lamp operating circuit **50** is supplied with electrical power from an electrical plug/socket connector **52** opening to the side of the lamp base **12**. For use in a motor vehicle headlamp, the lamp **10** is electrically connected to onboard electrical power and to ground via the connector **52**. The lamp operating circuit **50** integrated within the lamp base **12** provides all circuitry required to adapt the voltage supplied at connector **52** to the type of electrical driving voltage and current required for the operation of the burner **14** during ignition, following run-up and steady-state operation. The lamp operating circuit **50** comprises on a printed circuit board **58** and connected thereto circuitry and electrical components for ignition and operation of the lamp **10** as well as a microcontroller for controlling operation of to the burner **14**.

As visible from the exploded view shown in FIG. **3** (where some internal parts within the base are not shown for better understanding), the plastic holder **30** is enclosed within the aluminum housing **40**. As will be explained below, the holder **30** serves for mounting a plurality of components of the lamp operating circuit **50**, such as a transformer and the electrical plug/socket connector **52**. The holder **30** further holds electrical contacts of these components. The holder **30** is substantially box-shaped with side walls **34** and a top wall **38**. The top wall **38**, as shown in FIG. **2**, is oriented towards the burner **14**, covered by the metal housing **40**.

As visible in particular from the cross-sectional view of FIG. **2**, the burner **14** is mounted at a central opening **28**, and is arranged to protrude quite a distance axially along the longitudinal axis X into the lamp base **12**. The result of the corresponding arrangement of the burner **14** quite deep within the lamp base **12** leads to a reduced light center length (LCL), i.e. distance between the center of the discharge vessel **18** relative to the holding ring **32** comprising position reference elements for relative positioning within a reflector of a motor vehicle headlight unit.

As the burner **14** is thus installed to protrude into the lamp cap housing **12**, the electrical contact leads from the burner **14**, namely the central contact lead **22** and return contact lead **24**, also extend into the lamp cap housing **12**. In operation of the lamp **10**, and in particular during ignition, insulation needs to be provided to prevent flashover between the electrical contact leads **22**, **24** as well as from any of the contact leads **22**, **24** to components or contact leads of the lamp operating circuit **50** or parts of the lamp cap housing **12**. In order to provide this insulation, a plastic cap **60** is provided, covering the central contact lead **22** and the return contact lead **24** axially. The cap **60** serves to provide electrical insulation, in particular between the central contact lead **22** and return contact lead **24**, but also between the contact leads **22**, **24** and the metal bottom plate **44**.

Components of the lamp operating circuit **50** are arranged on a printed circuit board **58** provided within the lamp base **12**, holding and electrically interconnecting the electrical circuit components provided thereon. The printed circuit board (PCB) **58** with electrical components mounted on a top surface is arranged directly on the bottom plate **44**. Thus, there is close thermal contact between the lamp operating circuit **50** and the bottom plate **44**, so that the bottom plate **44** serves as heat sink.

The operating circuit **50** arranged within the base **12** comprises all necessary circuitry, such that the lamp **10** for all modes of operation requires only connection to the onboard voltage of a motor vehicle, which may be supplied at the plug/socket connector **52**. The operating circuit **50** includes an ignitor for supplying a high voltage to the burner **14** for igniting an arc discharge within the discharge vessel **18**. The operating circuit further comprises a driver circuit for generating an alternating current for operation of the burner **14** in a run-up period after ignition and in subsequent steady-state operation. The operating circuit **50** comprises a micro-controller for control of the operation of the components of operating circuit **50** and of the burner **14**.

As shown in FIG. **7**, the plug/socket connector **52** comprises three contacts **62** protruding within a socket cavity **64** formed within the holder element **30**. One of the contacts **62** is a ground contact, connecting the lamp **10** to electrical ground of the vehicle onboard electrical system. The other contacts are provided for a supply voltage (onboard voltage of the vehicle, e.g. 12 V) and for transmitting communication control signals from an electronic control unit (ECU) on board of the vehicle to the micro-controller of the operating circuit **50** and vice versa.

FIG. **4**-**7** show how the electrical contacts **62** of the plug/socket connector **52** are connected to the PCB **58** via contact path elements **70**, which are held by the holder **30**.

The contact path elements **70** are flat, elongate metal strips or webs. Corresponding to the three contacts **62** of the plug/socket connector **52**, there are three contact path elements **70** arranged in parallel within the base **12**, extending from the connector **52** to the PCB **58**. The contact path elements **70** are bent roughly L-shaped, as shown in FIG. **4** (where the holder **30** is not shown), FIG. **5**. Both ends of the contact path elements **70** are bent to form contact flaps **71***a*, **71***b* for contacting the electrical contacts **62** of the connector **52** and for contacting contact surfaces of the PCB **58**. Each contact flap **71***a* of the contact path element **70** is fixed to one plug contact **62** via spot welding, and each contact flap **71***b* is fixed to one contact surface **72** by soldering.

As visible from FIG. **4**, FIG. **5** (where the metal outer housing **40** is not shown), the contact path elements **70** extend from the connector **52** in a first portion **70***a* substantially in parallel to the upper surface of the base **12**, oriented towards the burner (i.e. horizontally in FIG. **4**, FIG. **5**). The first portion **70***a* of the contact path elements **70** is fixed to the holder **30** by partly embedding the first portion **70***a* of the contact path elements **70** within the plastic material.

The contact path elements **70** are bent at an angle of about 90° to continue as a second section **70***b* towards the PCB **58**, i.e. substantially in parallel to the longitudinal axis X of the lamp **10**. The second section **70***b* of the contact path elements **70** is held and guided by the holder **30**, but not fixed thereto. The holder **30** provides an elongate opening, through which the second section **70***b* of the contact path elements **70***a* protrudes, such that each of the metal webs is surrounded by the plastic material of the holder **30** in traverse directions. Thus, the second section **70***b* of the contact path elements **70** is slidably received within the opening of the holder **30**, such that it is movable in longitudinal direction while being guided in traverse direction by the enclosing plastic material.

During assembly of the lamp **10**, the assembled PCB **58** is connected to the holder **30** as shown in the exploded view of FIG. **3**, such that the second contact flaps **71***b* of the contact path elements **70** come to rest on the contact surfaces **72** of the PCB **58**.

In order to be able to establish a reliable solder connection, the holder **30** and the contact path elements **70** are pre-assembled with the length of the second section **70***b* designed for an interference fit, i.e. longer than necessary for an exact 90° bend between the first section **70***a* and second section **70***b* of the contact path elements **70**. Thus, before assembly, the contact flaps **71***b* extend out of the holder **30** to protrude a small distance below. As the PCB **58** is fitted, a force acts longitudinally on the second section **70***b* of a contact path element **70**, such that this section of the contact path elements **70** slides longitudinal within the guiding fit of the holder **30**. Within the base **12**, the holder **30** leaves a spring space **74** free, into which a third section **70***c* of the contact path elements is received as it is deflected by the force exerted on the second section **70***b* of the contact path elements **70**.

By providing the mentioned oversize, slidable reception and spring space **74**, a clamping fit of the contact flaps **71***b* on the contact surfaces **72** of the PCB **58** is achieved, where a spring force of the deflected third section **70***c* of the contact path elements **70** achieves a pressing force, pressing the contact flaps **71***b* onto the contact surfaces **72**. Subsequently, the solder connection is made.

The holder **30** comprises an opening **45** which allows access to the contact flaps **71***b* and contact surfaces **72** for soldering.

As already mentioned, one of the contacts **62** provided at the connector **52** is an electrical ground contact, connected to electrical ground of the motor vehicle. As shown in FIGS. **6**, **8**, a contact spring **76** is provided in one piece with one of the contact path elements **70** serving as the electrical ground contact, the contact spring **76** being provided to establish an electrical ground connection to the metal housing **40**.

The holder **30** includes an opening **78** provided within the top wall **38**. The contact spring **76** is fixed to the holder **30** and extends through the opening **78** up to the metal housing **40**.

As shown in the partial views of FIGS. **8**, **9**, the top surface **80** of the base **12** is a metal sheet element which is part of the metal housing **40** and is made from aluminum. A contact sheet element **82** is arranged flat underneath the top surface **80** of the metal housing **40** in close contact therewith. The contact sheet element **82** is a thin piece of sheet metal made from a steel material, considerably thinner than the aluminum sheet material of the top surface **80**.

The burner holding ring **32** includes a flange **33** extending downwardly up to the top surface **80**. The burner holding ring **32** is fixed to the base **12** by means of a crimping connection of the top surface **80** of the metal housing **40** with the flange **33**. As shown in FIG. **9**, the sandwich structure formed of the steel material of the contact sheet element **82** and the aluminum material of the top surface **80** of the metal housing **40** is bent at the central opening **28** for the burner **14** to surround the flange **33** of the burner holding ring **32**. The thus formed crimping connection extends around the substantially circular opening **28** in the top surface **80** provided for the burner **14** and is effective to both fix the flange **33**, and thereby the burner holding ring **32** to the top surface **80**, and also to provide a close mechanical (and thereby also electrical) connection between the contact sheet element **82** and the top surface **80** of the metal housing **40**.

As shown in FIG. **6**, FIG. **8**, the contact spring **76** provides two contact fingers **84** which bear against the lower surface of the contact sheet element **82** in a clamping fit. Thus, the electrical ground connection provided at the connector **52** is brought into electrical contact with the metal housing **40** via the contact spring **76** and the contact sheet element **82**.

As already explained, the operating circuit **50** comprises an ignitor for igniting an electrical arc discharge within the discharge vessel **18**. The ignitor includes an ignition transformer **54** as shown in FIG. **2**, arranged within an insulation chamber **42** with side walls formed integrally with the holder **30**. The ignition transformer **54** is embedded, for purposes of electrical insulation, within an insulation compound **43**.

The insulation compound **43** is a silicone insulation compound, which is filled into the insulation chamber **42** in upside-down orientation, as e.g. shown in FIG. **6**. The transformer **54** is placed within the insulation chamber **42**, and the insulation compound **43** is filled into the chamber **42** in a liquid form. The holder **30** including the filled insulation chamber **42** is then placed into an oven for a heat curing treatment of the insulation compound **43**, such that the insulation compound **43** solidifies.

During filling of the insulation chamber **42** in the upside-down orientation as shown in FIG. **6**, any amounts of the liquid insulation compound **43** possibly leaking from the insulation chamber **42** into the interior of the holder **30** are retained by a retention wall **46** provided around the central opening **28**. Thus, leaked amounts of the insulation compound **43** will not leak through the opening **28** onto the in the upside-down orientation of FIG. **6**—bottom surface of the holder **30**, i.e. onto the top surface (in FIG. **2**) of the base **12**, exposed to heat and radiation from the burner **14**. Thus, evaporation of silicone, and in particular silicone entering the front parts of the lamp **10** and the reflector, into which the lamp **10** will be mounted, is effectively prevented.

The central opening **28** in the top wall **38** of the holder **30**, through which the burner **14** protrudes, is connected with a further opening in the top wall **38**, through which the return contact **24** enters the base **12**. The retention wall **46** is arranged to surround both openings. Further, the top wall **38** of the holder **30** includes, as already explained, an opening **78** for the ground contact spring **76**. The opening **78**, as shown in FIG. **8**, is also surrounded by raised retention walls **48**, extending, in the same way as the retention wall **46** around the central opening **28**, perpendicularly from the top wall **38** of the holder **30**. Thus, even larger amounts of leaked insulation compound **43** are safely retained within the holder **30** until the curing treatment. During the curing treatment, leaked compound **43** within the interior of the holder **30** will solidify as well, such that there is no further risk of silicone entering the front portions of the lamp **10**.

As shown in the figures, in particular FIG. **2**, the packaging of electrical components and contacts within the base **12** is particularly dense, such that the distances between the electrical components are small. In order to reduce the risk of EMI, in particular from the ignitor components, such as the ignition transformer **54**, a metal shield **36**, as shown in FIG. **10**, is arranged within the base **12**. The metal shield **36** is arranged substantially in parallel to the top and bottom surfaces of the base **12**, e.g. substantially horizontally, as shown e.g. in FIG. **2**, FIG. **4**. The metal shield **36** is arranged to partly cover the PCB **58**, and in particular to separate components on the PCB **58** from the ignition transformer **54**. Further, as shown in FIG. **2**, the metal shield **36** is also arranged to partly shield the plug/socket connector **52** and the contact leads **70** from further components within the base **12**, in order to prevent EMI from spreading within the base **12** via these connections.

While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive; the invention is not limited to the disclosed embodiments.

Variations of the disclosed embodiment can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure and the appended claims. In the claims, the word "comprising" or "including" does not exclude other elements, and the indefinite article "a" or "an" does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope.

The invention claimed is:

1. Lamp comprising

a burner fixed to a lamp base,

where the lamp base comprises at least a metal housing part, said metal housing part comprising a contact sheet element made out of a metal material different from the material of said metal housing part,

and where electrical contacts are provided within said base, said electrical contacts comprising an electrical ground contact, wherein a contact spring is provided for contacting said electrical ground contact to said metal housing part,

where said contact spring is arranged to press against said contact sheet element to provide electrical ground connection to said metal housing part.

2. Lamp according to claim **1**, where

said contact sheet element and said metal housing part are flat elements provided with their surfaces on top of each other.

3. Lamp according to claim **1**, where

said contact sheet element said metal housing part are connected by a deformation of both, thereby mechanically locking said contact sheet element and said metal housing part.

4. Lamp according to claim **3**, where

said contact sheet element and said metal housing part are connected by a crimping or riveting connection.

5. Lamp according to claim **1**, where

said metal housing part comprises at least a top surface of said base oriented towards said burner,

said burner comprising a burner holding element fixed to said metal housing part by a deformation of said metal housing part and of said contact sheet element.

6. Lamp according to claim **1**, where

a non-conductive holder element for holding electrical components and/or electrical connections of a lamp operating circuit is disposed within said base, where said contact spring is fixed to said non-conductive holder element.

7. Lamp according to claim **6**, where

said non-conductive holder element comprises an opening,

and where said contact spring extends through said opening.

8. Lamp according to claim **1**, where

said lamp base comprises an electrical plug/socket connector comprising at least said electrical ground contact.

9. Lamp according to claim 1, where
said contact spring comprises at least two spring tongues pressing against said contact sheet element.
10. Lamp according to claim 1, where
said metal housing part is made of aluminum material.
11. Lamp according to claim 1, where
said contact sheet element is made out of steel material.

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